Space Weather Technical Forecast

Issued on Sunday, 05 February 2023 at 13:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1/Minor Storm intervals on days 2 and 3 (6th and 7th). Probable increase in X-ray flare activity through period from arriving regions.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with all sunspot regions on the visible disc relatively small and magnetically simple Beta regions. There are presently five regions on the disc, with a new region developing in the southwest quadrant over the past 12 hours.
The most notable flares during the period were a C6.6, near the southeast limb at 05/0326 UTC and a C6.4 from AR3211 in the southwest quadrant at 05/1050 UTC. The first of these appears to be associated with a CME from the southeast limb, which is considered to be non-Earth directed. There appears to be some dimming present in the region in the second one, but a CME is not yet visible in LASCO or STEREO coronagraph imagery. A small faint CME can be seen in coronagraph imagery leaving the northwest limb of the Sun around 05/0600 UTC. This is thought to be from the far side and at this stage no Earth-directed CMEs are believed to have occurred during the period.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by DSCOVR and ACE at L1, were indicative of slow-ambient wind regime, with speeds ranging between 300 and 400 km/s. The solar wind density was generally below average (<5 ppcc). The IMF was Weak throughout, while the north-south component, Bz, was also at weak levels between -5 nT and +6 nT. The phi angle was mostly negative (towards the Sun), although a period of positive was observed (04/1510-1745 UTC). Resultant geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at Background levels throughout.
The high energy electron flux (greater than 2MeV) measured by GOES16 was predominantly at Normal Background levels. The associated 24-hour electron fluence was below the Active threshold on a declining trend. The observed fluence at 05/0001 UTC, was 1.19e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low solar activity is likely during the forecast period. There are signs that the arriving eastern limb contains more potent active regions (from CME evidence, prominences and STEREO A EUVI 195 imagery), with a probable increase in activity therefore considered through the coming UTC working week, and thus an increasing chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs feature in the forecast at present. Ambient solar winds are expected to become elevated on day 2 (6th) due to negative coronal hole influences. Predominantly Quiet geomagnetic activity is expected to become Unsettled to Active on day 2 (6th), with a chance of G1 Minor Geomagnetic Storm intervals.

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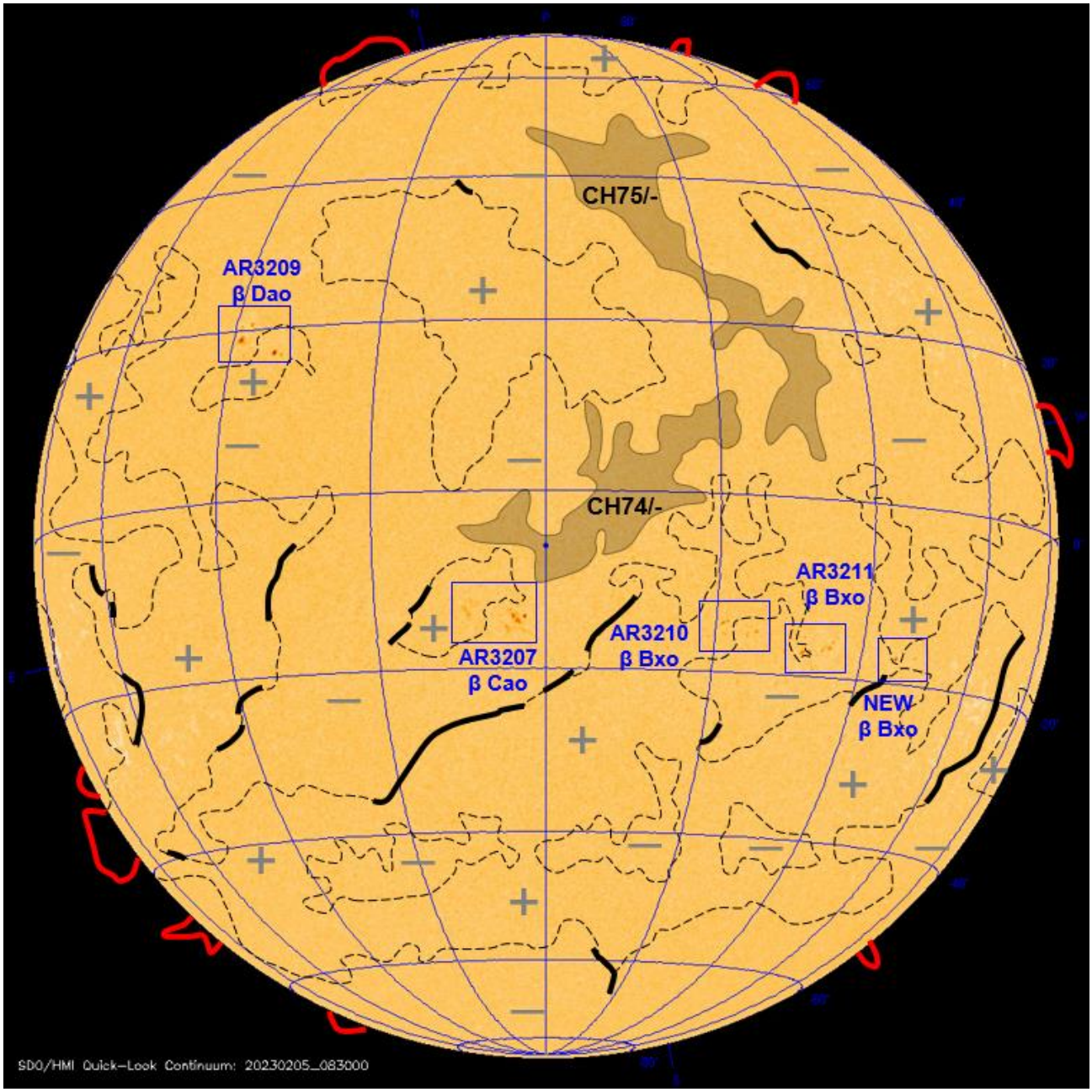
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at Background levels throughout given the dearth of current sunspot groups.
Background electron flux is likely to increase to Moderate or perhaps High levels on days 3 and 4 (7th and 8th), due to the fast wind environment, although the corresponding electron fluence is unlikely to exceed the Active (1e8 integrated pfu) threshold in the forecast time frame.

Figure 1. Solar Analysis Valid 05/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth directed CMEs currently in the forecast.
Solar winds are currently at ambient levels, but are expected to become elevated on day 2 (6th) due to the arrival of fast winds from CH74/- and CH75/-. An enhanced solar wind environment is then expected to persist through the remainder of the period. At the time of writing there is no evidence to suggest the fast wind regime has reached STEREO A, and thus the enhancement is at least 24 hours from affecting Earth and is likely to occur during the second half of day 2 (6th).

Predominantly Quiet geomagnetic activity is expected to become Unsettled to Active on day 2 (6th), with a chance of G1 Minor Geomagnetic storm intervals. On day 4 (8th) activity is likely to reduce to Quiet to Unsettled levels, as the effects of the coronal holes begins to reduce.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	30	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil

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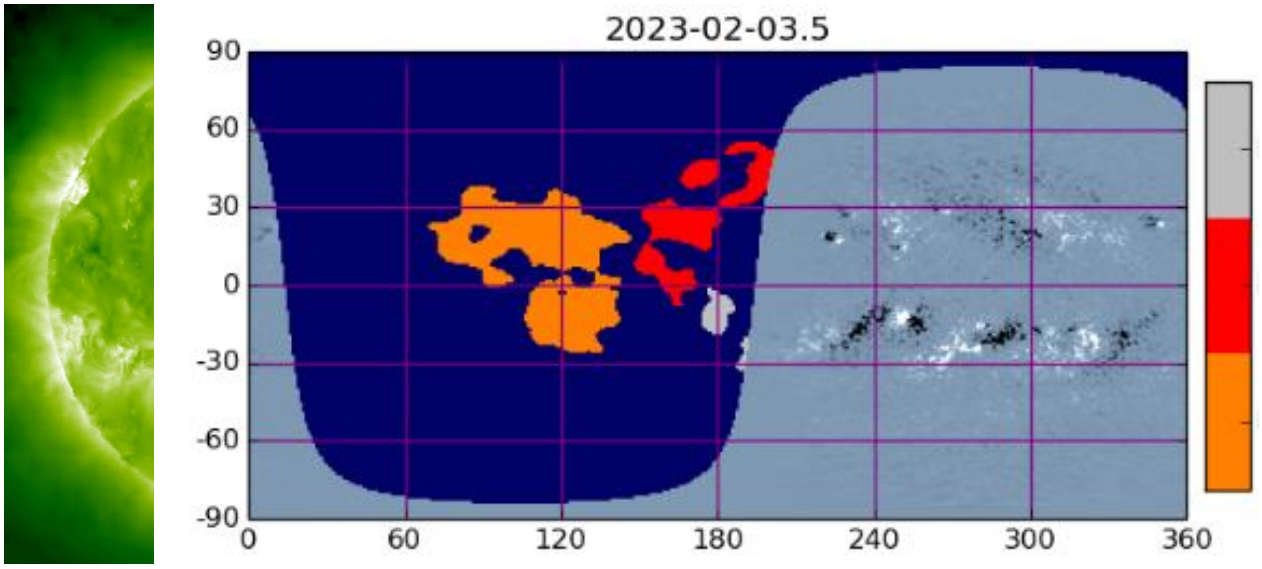
Radio Blackouts - X-Ray Flares:

The current solar disc consists of relatively few and simple bipolar sunspot groups, with Low solar activity. This is most likely to continue through the forecast period. However, there is the potential for the arrival of numerous Carrington locations for spot groups over the eastern limb. In numerical order Ex-AR3286; 3288; 3290; 3291; 3292; 3294 and 3295 are all due over the coming days. Adding to this evidence is STEREO A EUVI195 imagery, which suggests a southern solar hemisphere bright flux region (perhaps newly-developed), as well as far-side helioseismography, which shows an eastern hemisphere bias of signals from the far side, implying the new arrivals will probably be more significant the week after (mid-month). Therefore there is an increasing chance through the period of moderate solar activity and isolated M-class flares. There is the possibility that this risk may increase significantly during the period as new regions rotate on to the visible disc.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	20	20	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: STEREO A EUVI195 imagery (left) showing the imminent eastern limb as of 05/1155UTC, as well as a far-side helioseismograph (right) showing possible upcoming regions on the far-sided eastern solar hemisphere.



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Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux as observed by GOES16 is at Background levels, and is currently expected to remain as such throughout the period given the absence of significant sunspot groups.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at Normal Background levels, and is expected to remain so in the near-term. However, an increase to Moderate and perhaps High levels is likely during days 3 and 4 (7th and 8th) due to the onset of a coronal hole fast wind environment. However, it is unlikely that this increase will be sufficient enough to cause the electron fluence to exceed the Active (1e8 integrated pfu) threshold in this time frame, although a rising trend is likely later in the period.
MOSWOC REFM is rendered less useful for this forecast period as the solar wind enhancement is non-persistent.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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